

## CLAIMS

### What is claimed is:

1. An ultra-wideband receiver comprising:
  - a template generator structured to generate a local signal similar to an incoming signal;
  - a single correlator structured to correlate the incoming signal with the local signal;
  - at least one filter in communication with the correlator;
  - an energy estimator in communication with the at least one filter; and
  - a pulse detector in communication with the at least one filter.
2. The ultra-wideband receiver of claim 1, wherein the template generator comprises:
  - a timing signal generator that generates a periodic signal;
  - a gate that gates the periodic signal to produce the local signal; and
  - an amplifier in communication with the gate.
3. The ultra-wideband receiver of claim 2, wherein the gate is an AND gate.
4. The ultra-wideband receiver of claim 1, wherein the local signal is a pulse of electromagnetic energy.
5. The ultra-wideband receiver of claim 4, wherein the pulse of electromagnetic energy has a duration ranging from about 10 picoseconds to about 1 millisecond.

6. The ultra-wideband receiver of claim 1, wherein the incoming signal comprises a plurality of pulses of electromagnetic energy.

7. The ultra-wideband receiver of claim 6, wherein the plurality of pulses of electromagnetic energy comprise a plurality of ultra-wideband pulses.

8. The ultra-wideband receiver of claim 7, wherein each of the plurality of ultra-wideband pulses has a duration ranging from about 10 picoseconds to about 1 millisecond.

9. The ultra-wideband receiver of claim 1, wherein the incoming signal is modulated by at least one technique selected from a group consisting of: ternary modulation, binary phase shift keying, pulse amplitude modulation, and pulse position modulation.

10. The ultra-wideband receiver of claim 1, wherein the single correlator comprises:  
a first filter;  
a mixer;  
a second filter; and  
an amplifier.

11. The ultra-wideband receiver of claim 10, wherein the first filter has a transfer function similar to a transmitter output filter.

12. The ultra-wideband receiver of claim 10, wherein the first filter is a band-pass filter.
13. The ultra-wideband receiver of claim 10, wherein the mixer is a multiplier configured to multiply the local signal with the incoming signal.
14. The ultra-wideband receiver of claim 10, wherein the second filter is a low-pass filter.
15. The ultra-wideband receiver of claim 10, wherein the amplifier is an automatic gain control amplifier.
16. The ultra-wideband receiver of claim 1, wherein the energy estimator comprises:  
an absolute value detector; and  
an integrator.
17. The ultra-wideband receiver of claim 16, wherein the absolute value detector is a square law detector.
18. The ultra-wideband receiver of claim 16, wherein the integrator is configured to integrate the signal over a predetermined time period.

19. The ultra-wideband receiver of claim 18, wherein the predetermined time period ranges from about 100 nanoseconds to about 1 millisecond.
20. The ultra-wideband receiver of claim 18, wherein the predetermined time period is 1 microsecond.
21. The ultra-wideband receiver of claim 1, wherein the pulse detector comprises:  
a sample-and-hold function; and  
an analog-to-digital converter.
22. The ultra-wideband receiver of claim 21, wherein the analog-to-digital converter is a multi-level analog-to-digital converter.
23. The ultra-wideband receiver of claim 22, wherein the multi-level analog-to-digital converter is selected from a group consisting of: a 2 level analog-to-digital converter, a 4 level analog-to-digital converter, a 6 level analog-to-digital converter, and a 8 level analog-to-digital converter.
24. A method of receiving and demodulating an ultra-wideband signal, the method comprising the steps of:  
receiving the ultra-wideband signal, the ultra-wideband signal comprising a plurality of ultra-wideband pulses;  
generating a template signal;

correlating the ultra-wideband signal with the template signal;  
estimating a coarse timing reference from a correlation of the ultra-wideband signal and the template signal;  
updating the template signal based on the coarse timing reference;  
correlating the ultra-wideband signal with the updated template signal; and  
detecting an ultra-wideband pulse from the correlation of the ultra-wideband signal and the updated template signal.

25. The method of claim 24, wherein each of the plurality of ultra-wideband pulses has duration ranging from about 10 picoseconds to about 1 millisecond.

26. The method of claim 24, wherein the plurality of ultra-wideband pulses is modulated by at least one method selected from a group consisting of: ternary modulation, binary phase shift keying, pulse amplitude modulation, and pulse position modulation.

27. The method of claim 24, wherein the step of correlating the ultra-wideband signal with the template signal comprises:

    multiplying the ultra-wideband signal and the template signal to produce a product signal; and

    attenuating a high frequency component of the product signal.

28. An ultra-wideband receiver comprising:

- a template generator that generates a local signal similar to an incoming signal;
- a single correlator structured to update the local signal based on the incoming signal and recover data;
- at least one filter connected to the correlator;
- an energy estimator connected to the at least one filter; and
- a pulse detector connected to the at least one filter.

29. A method of receiving and demodulating an ultra-wideband signal, the method comprising the steps of:

- means for receiving the ultra-wideband signal, the ultra-wideband signal comprising a plurality of ultra-wideband pulses;

- means for generating a template signal;

- means for correlating the ultra-wideband signal with the template signal;

- means for estimating a coarse timing reference from a correlation of the ultra-wideband signal and the template signal;

- means for updating the template signal based on the coarse timing reference;

- means for correlating the ultra-wideband signal with the updated template signal;

and

- means for detecting an ultra-wideband pulse from the correlation of the ultra-wideband signal and the updated template signal.